WHAT IS CLAIMED IS:

1. A magnetic composite material comprising at least two phases and used as a working substance in a magnetic refrigeration system, wherein

a first phase is composed of an intermetallic compound represented by a general formula:

$$La(Fe(Co, Ni)Si)_{13},$$

having an $NaZn_{13}$ type crystal structure, and precipitated in an expansion size of 100 μm or less in average; and

a second phase is composed of an iron alloy containing Si.

2. The magnetic composite material according to claim 1, containing Fe as a principal component, La in an amount from 4 atomic % to 12 atomic %, Si in an amount from 2 atomic % to 21 atomic %, and Co and Ni in a total amount from 0 atomic % to 11 atomic %; and the total amount of Fe, Co and Ni being from 75 atomic % to 92 atomic %.

3. The magnetic composite material according to claim 1, wherein the second phase has a body-centered cubic crystal structure or a face-centered cubic crystal structure.

4. The magnetic composite material according to claim 1, further comprising a third phase composed of a compound containing La as a principal element.

5. A particle formed of a magnetic composite

material which is constituted of at least two phases and used as a working substance in a magnetic refrigeration system, wherein

a first phase is composed of an intermetallic compound represented by a general formula:

$$La(Fe(Co, Ni)Si)_{13},$$

having an $NaZn_{13}$ type crystal structure, and precipitated in an expansion size of 100 μm or less in average;

a second phase is composed of an iron alloy containing Si; and

the particle is a sphere or a spheroid of 0.2 mm or more in the minor axis and 2 mm or less in the major axis.

6. The particle formed of a magnetic composite material according to claim 5, wherein the magnetic composite material contains Fe as a principal component, La in an amount from 4 atomic % to 12 atomic %, Si in an amount from 2 atomic % to 21 atomic %, and Co and Ni in a total amount from 0 atomic % to 11 atomic %; the total amount of Fe, Co and Ni being from 75 atomic % to 92 atomic %.

7. The particle formed of magnetic composite material according to claim 5, wherein the second phase is a body-centered cubic crystal structure or a face-centered cubic crystal structure.

8. The particle formed of magnetic composite

material according to claim 5, further comprising a third phase composed of a compound containing La as a principal element.

9. A magnetic material sintered body used as a working substance in the magnetic refrigeration system, prepared by sintering particles constituted of at least two phases at a temperature lower than a melting point of the magnetic composite material, thereby combining the particles through diffusion of constituent elements, wherein

a first phase is composed of an intermetallic compound represented by a general formula:

$$La(Fe(Co, Ni)Si)_{13},$$

having an $NaZn_{13}$ type crystal structure, and precipitated in an expansion size of 100 μm or less in average;

a second phase is composed of an iron alloy containing Si; and

the particle is a sphere or a spheroid of 0.2 mm or more in the minor axis and 2 mm or less in the major axis.

10. The magnetic material sintered body according to claim 9, wherein the magnetic composite material contains Fe as a principal component, La in an amount from 4 atomic % to 12 atomic %, Si in an amount from 2 atomic % to 21 atomic %, and Co and Ni in a total amount from 0 atomic % to 11 atomic %;

the total amount of Fe, Co and Ni being from 75 atomic % to 92 atomic %.

11. The magnetic material sintered body according to claim 9, wherein the second phase is a body-centered cubic crystal structure or a face-centered cubic crystal structure.

12. The magnetic material sintered body according to claim 9, further comprising a third phase composed of a compound containing La as a principal element.

13. The magnetic material sintered body according to claim 9, wherein the particles composed of the magnetic composite material are contained in 70 % by weight or more and a voidage from 25% to 60%.

14. A method for producing a magnetic composite material for use in a magnetic refrigeration system as a working substance, comprising:

a first step of producing an ingot comprising, as a main phase, an Si-containing iron alloy of a body-centered cubic structure which is formed by melting a raw material containing Fe as a principal component, La in an amount from 4 atomic % to 12 atomic %, Si in an amount from 2 atomic % to 21 atomic %, and Co and Ni in a total amount from 0 atomic % to 11 atomic %; the total amount of Fe, Co and Ni being from 75 atomic % to 92 atomic %;

a second step of producing a particle, plate or wire form intermediate constituted of at least

two phases including a main phase formed of an Si-containing iron alloy and a sub phase formed of La as a principal component; and

a third step of subjecting the intermediate to annealing to diffuse constituent elements each other, thereby precipitating an intermetallic compound represented by a general formula:

$$La(Fe(Co, Ni)Si)_{13},$$

and having an $NaZn_{13}$ type crystal structure.

15. The method according to claim 14, wherein,

in the second step, the ingot is processed into an electrode rod, which is then melted by a rotating electrode process to obtain the intermediate of particle form.

16. The method according to claim 14, wherein the intermediate is a spherical or a spheroidal particle having the minor axis of 0.2 mm or more and the major axis of 2 mm or less.

17. The method according to claim 14, wherein the intermediate is a plate manufactured by rolling the ingot.

18. The method according to claim 14, wherein the intermediate is a wire manufactured by drawing the ingot.

19. A magnetic refrigeration system comprising

a magnetic refrigerating chamber packed with a magnetic material;

an inlet pipe for introducing a heat exchange medium into the magnetic refrigerating chamber;

an outlet pipe for discharging the heat exchange medium from the magnetic refrigerating chamber;

movable permanent magnets arranged in the proximity of the magnetic refrigerating chamber; and

a driving unit for moving positions of the permanent magnets relative to the magnetic refrigerating chamber, thereby applying a magnetic field to and removing the magnetic field from the magnetic material,

wherein

the magnetic material is a magnetic composite material constituted of at least two phases including

a first phase composed of an intermetallic compound represented by a general formula:

$$La(Fe(Co, Ni)Si)_{13}$$

having an $NaZn_{13}$ type crystal structure, and precipitated in an expansion size of 100 μm or less in average; and

a second phase is composed of an iron alloy containing Si.

20. A magnetic refrigeration system comprising:

a magnetic refrigerating chamber packed with a magnetic material;

an inlet pipe for introducing a heat exchange medium into the magnetic refrigerating chamber;

a first outlet pipe for discharging the heat exchange medium used in precooling of the interior of the magnetic refrigerating chamber, from the chamber;

a second outlet pipe for discharging the heat exchange medium cooled in the magnetic refrigerating chamber, from the chamber;

movable permanent magnets arranged in the proximity of the magnetic refrigerating chamber;

a driving unit for moving positions of the permanent magnets relative to the magnetic refrigerating chamber, thereby applying a magnetic field to and removing the magnetic field from the magnetic material, and

a flow channel controlling unit for switching discharging channels of a heat exchange medium from the magnetic refrigerating chamber between the first outlet pipe and the second outlet pipe in synchronisms with relative movement of permanent magnets,

wherein

the magnetic material is a magnetic composite material constituted of at least two phases including

a first phase composed of an intermetallic compound represented by a general formula:

$$La(Fe(Co, Ni)Si)_{13}$$

having an $NaZn_{13}$ type crystal structure, and precipitated in an expansion size of 100 μm or less in average; and

a second phase is composed of an iron alloy containing Si.